



White Sands Test Facility Job Instruction

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MANUFACTURING OF IGNITERS FOR NHB 8060.1 TESTING

Work Authorizing Document: Test Preparation Sheet

Prepared By:

ORIGINAL SIGNED BY:

Rosemary Robles

Engineer

AlliedSignal Technical Services Corp.

Reviewed By:

ORIGINAL SIGNED BY:

D. B. Hirsch

Standard Test Section Supervisor

AlliedSignal Technical Services Corp.

Approved By:

ORIGINAL SIGNED BY:

Jim Williams

Laboratories Department

NASA

1. PURPOSE

The purpose of this WJI is to incorporate a standard procedure to prepare, certify, and ship standard NHB 8060.1B and NHB 8060.1C igniters for flammability testing and to update LJI-320-35-18. This WJI will be reviewed yearly for applicability.

2. REFERENCES

- a. Operations and Maintenance Manual for the bench-mounted conveyor belt
- b. NASA Handbook 8060.1B and NASA Handbook 8060.1C
- c. WSTF Laboratories Department Chemical Hygiene Plan

3. ATTACHMENTS

- a. Attachment A, Yearly Review of the Document for Applicability

4. GENERAL INFORMATION

The operations are divided into five parts as follows:

- A. Preparing the igniter mix
- B. Extruding the igniters
- C. Curing, cutting, and weighing the igniters
- D. Certifying the igniters
- E. Packaging, storing, and shipping the igniters

5. SAFETY REQUIREMENTS

- A. All personnel associated with the manufacturing of the igniters must read the MSDSs and be familiar with safety requirements and emergency treatment written in the MSDSs before working with the materials. All personnel operating the extruder and conveyor belt should be familiar with the safety precautions of each.
- B. All personnel handling the wet or dry ingredients must wear protective gloves and safety glasses. Safety glasses are not required when handling the cured igniters; however, safety glasses are necessary when certifying a batch of igniters.
- C. All personnel grinding the hexamethylenetetramine must wear a respirator with organic canisters. The person must be certified to wear the respirator.

- D. All personnel is to be familiar with the location of the eyewash station. Note:
The eyewash is located outside the door on the north side of the building.

6. INSTRUCTIONS

01-000 **Preparing the igniter mix**

01-001 *MATERIALS SPECIFICATION*

- a. Hexamethylenetetramine (HMT) is obtained from Alfa Products in 2 kg containers. The HMT is usually a 98% pure reagent grade compound which usually comes in a powder form. It must be packaged and stored properly to prevent moisture contamination.
- b. Anhydrous sodium metasilicate may be obtained from Aldrich Chemical Company in 1 kg bottles. The sodium metasilicate is a 98% pure reagent grade compound which is usually in a granule form. It must be packaged and stored properly to prevent moisture contamination.
- c. Gum arabic (acacia) may be obtained from VWR Scientific in 500 gram containers and is usually in a powder form.

01-002 *GRINDING THE IGNITER MIX*

- a. To achieve a homogeneous mixture, the raw materials are to be ground using the hammer mill. Grinding is not necessary for the gum arabic.
- b. Sodium metasilicate is to be ground in the glove box. Place the hammer mill, the material required to be ground, and other tools necessary inside the glove box including a temperature/humidity meter. Attach a bag to the output end of the hammer mill with tape to capture the ground material. In addition, place the 040 screen inside the hammer mill. Seal the glove box and before grinding the material, purge the glove box with dry air for approximately four hours or until the humidity is below ten percent.

NOTE

IT IS RECOMMENDED THAT LARGE QUANTITIES OF THE MATERIALS BE GROUND AT ONE TIME TO AVOID CLEANING THE HAMMER MILL AND OPERATING THE GLOVE BOX FREQUENTLY. FOR EXAMPLE, A ONE KG BOTTLE OF SODIUM METASILICATE

COULD BE GROUND AT ONE TIME.

- 01-002 c. Turn the hammer mill on and place or pour the material into the hopper at a consistent rate. Continue to grind the material until the full amount of raw material placed into the glove box has been ground. Detach the bag from the hammer mill, seal and place the ground material into another container.
- d. The hexamethylenetetramine is to be ground in the fume hood. The required air velocity of the fume hood is to be at 100 linear feet/second and a respirator with organic canisters must be worn. Follow the same procedures used when grinding the sodium metasilicate.
- e. Clean the hammer mill between the grinding of different materials in the fume hood. To clean the hammer mill, operate the hammer mill as usual passing a small amount of sand to loosen the caked on material. Open the hammer mill, using an air hose blow off any remaining material. If too much material remains in or near the rotor, remove the rotor. If the rotor is removed, do not place the rotor in water (the rotor will corrode). Clean the rotor by carefully brushing the material off the rotor using a soft metal brush. Do not lose the small stainless steel ball if the rotor is removed. Replace all of the stainless steel balls when the hammer mill is reassembled.
- f. After grinding, store each material separately. Double bag the material and heat seal each bag. Identify the grounded material and store.

01-003 *WEIGHING THE IGNITER MIX*

NOTE

DO NOT MIX THE COMPONENTS OF THE IGNITER MIX PRIOR TO EXTRUSION.

- a. Mix the following amounts of each solid ingredient to make a 400-gram mixture:
- (1) 280.8 \pm 0.2 grams hexamethylenetetramine
 - (2) 105.2 \pm 0.2 grams sodium metasilicate, anhydrous
 - (3) 14.0 \pm 0.2 grams gum arabic

- b. If a different size batch needs to be made, then the mixture should be comprised of $70.2 \pm 0.1\%$ hexamethylenetetramine, $26.3 \pm 0.1\%$ sodium metasilicate, and $3.5 \pm 0.1\%$ gum arabic.
- c. On the day of extrusion, weigh the appropriate amount of each material and mix them thoroughly.

01-004 *MIXING THE IGNITER MIX WITH WATER*

WARNING

PERFORM THE FOLLOWING STEPS IN A FUME HOOD OPERATING ACCORDING TO THE MANUFACTURER'S INSTRUCTIONS

- a. Pour 200 ml of deionized water at room temperature into the 250 ml buret.
- b. Open the buret, pour approximately 10 ml of deionized water into the mixing bowl.
- c. Place the dry igniter mix into the mixing bowl. Ensure the igniter mix is evenly distributed in the mixing bowl.
- d. Turn the mixer on to speed 1. Initially, the contents will be very wet. As the sodium metasilicate absorbs the water, the mix will start to thicken and eventually achieve a dough like consistency. This could take 20-30 minutes depending on ambient conditions. During mixing, the sides of the mixing bowl will have to be scrapped with a spatula occasionally to avoid the mix from setting up.
- e. As the dough-like consistency is achieved, the mix will start to be pulled off the sides of the bowl. The mixer can be stopped at times to scrape the sides.

02-000 **Extruding the igniters**

02-001 When extruding the igniter mix three individuals will be needed. One individual will place Teflon trays onto the conveyor belt, one individual will control the process by adjusting the conveyor belt speed, extruder controller speed, and separating the strands between trays with a cutting tool, and one individual will remove the trays from the conveyor belt and place them on drying racks.

02-002 Plug in the conveyor belt and initially set the speed control dial to 50.

Turn on the conveyor belt and make any necessary belt tension adjustments to prevent any belt hesitations. In addition, make sure there are approximately 75 Teflon trays (3" x 15" x 1/16") on hand next to the beginning of the conveyor belt. Turn the conveyor belt off.

02-003 Assemble the extruder according to the following steps:

- a. Obtain the piston and place the guide rings and T-seal assembly onto the piston.
- b. Place the stainless steel ball into the opening of the piston.
- c. Attach the piston to the coupling motor housing with the bolt and screw.
- d. Fill the housing with blended mixture and push it down to the bottom.
- e. Place the housing into housing base plate assembly.
- f. Lubricate the guide rings and T-seal assembly with Krytox.

02-004 Attach a flexible plastic tube to the air outlet valve of the housing to allow entrapped air to escape. Turn on the power to the conveyor belt and the extruder controller. Ensure the actuator is operating in the forward mode and initially set the speed control dial of the extruder controller to 70-80 to carefully guide the piston into the housing.

02-005 Once the piston is fully into the housing, reduce the speed of the extruder controller to approximately 20 and wait for the extrusion to start. Once the extrusion starts, stop the actuator by setting the controller to zero. Next, turn the conveyor belt on and be ready to place the Teflon trays on the conveyor belt as the igniter mix exits the housing. Turn the extruder controller to between 15-20. Adjust the conveyor belt and the extruder speed, as required, to ensure that the extruded product comes out straight and unstretched.

02-006 The extruder has a built in safety limit switch which will turn off the actuator when the piston reaches the edge of the housing. To ensure most of the igniter mix has been used, let the extruder reach this point when extruding igniters. Allow the piston to sit for approximately five minutes before reversing. Reverse the direction of the piston on the controller and let the piston withdraw from the housing with the extruder controller set between 70-80. The actuator will stop when the limit switch is activated. Remove the housing and the piston and wash them with water at room temperature in a basin of water. The housing might need to be soaked if the material has hardened on the piston. Clean the mixing bowl and all of the tools used in the process.

WARNING

DO NOT DISPOSE THE WATER IN A SINK. PLACE THE WASTE WATER INTO A PLASTIC BASIN. CALL THE ENVIRONMENTAL SECTION TO DISPOSE OF THE WASTE WATER PROPERLY.

03-000 Curing, cutting, and weighing the igniters

- 03-001 After all the igniter mixture has been extruded onto Teflon trays, the igniters should be placed in a well ventilated area to dry. After approximately 24-48 hours, the igniters should be dry enough to be cut.
- 03-002 Using a cutting tool, cut all the igniter strands on the Teflon trays to a length of 28.6 ± 3.2 mm ($1\text{-}1/8 \pm 1/8$ in.). Continue to dry the cut igniters at ambient conditions for another 24-48 hours until they are dry to the touch.
- 03-003 Transfer the dried igniters from the Teflon trays into a corrugated cardboard sheet.
- 03-004 Transfer the igniters from the corrugated cardboard sheet into the desiccant box by placing them directly on the desiccant bed.
- 03-005 Continue to dry the igniters inside the desiccant box to the final dried state. After approximately seven days, select ten igniters at random and weigh them. The weight specification for the igniters is 0.190 to 0.240 g. If eight out of ten igniters weigh in the specified range, it is an indication that the final dried state has been reached, and that the igniters are ready for certification. If more than two igniters weigh over 0.240 g, continue to dry the igniters.
- 03-006 After approximately 24-48 hours again select at random ten igniters. If eight out of ten igniters meet the weight specification as indicated in the step above, the igniters are ready for certification. Note: Due to ambient conditions within the desiccant box it may take two or more weeks for the igniters to dry.

04-000 Certifying the igniters

- 04-001 Weigh all the igniters in the desiccant box. If an igniter weighs below 0.190 g, it is underweight, and must be discarded. If an igniter weighs over 0.240 g, it can be cut down to 25.4 mm (1.0 in.) to achieve the weight specification. If the weight is not achieved within the length specification, the igniter must be discarded. Cutting and weighing of the igniters should be done in a dry environment, since the igniters will absorb moisture when exposed to excessive amounts of humidity. In addition, the igniters must remain circular and not flatten out while curing in order to fit inside the test coil. While the igniters are being cut and weighed, they should be placed in a plastic container inside the

grooves of a piece of corrugated wrap.

- 04-002 Select at random a sample of 20 igniters made from each 400-gram mixture. The igniters will be tested for the peak flame temperature, burn duration, and peak flame height to certify the entire batch. Each igniter must develop a flame temperature of 1100 ± 90 °C (2000 ± 160 °F). The igniter flame must also be sustained for 25 ± 5 seconds with a peak flame height of 6.4 ± 0.64 cm (2.5 ± 0.25 inches).
- 04-003 Igniters will be tested in a 120-liter propagation chamber in certified breathing air at 14.7 psia. The temperature shall be measured by a type S thermocouple constructed with a 0.81 mm (0.032 in.) diameter wire. The measurement will be accomplished using the computerized data acquisition (or any other certified alternate reading mechanism). The thermocouple wire should be centered geometrically 25.4 mm (1.0 in.) above the top of the igniter. To initiate the igniter, a voltage source capable of providing 15 amperes (RMS) should be connected to a No. 20 gage, bare nickel chromium wire. The wire should have a nominal resistivity of 2.3 ohms-per-m (0.7 ohms-per-ft) and should have sufficient length to wrap three, equally spaced turns around the igniter. The nickel chromium wire coil must be replaced before certifying each batch of igniters. In addition, the leads to the nickel chromium wire coil cannot exceed 31.8 mm (1.25 in.) to ensure proper ignition of the igniter. The K-bottle air must be attached and set-up for the 120-liter propagation chamber by following the procedures outlined in LJI 320-34-025, latest revision. Place a calibrated ruler in the test chamber to measure the flame height. The engineer in charge of the igniter project must be present when certifying igniters.
- 04-004 Before starting the certification, ensure that the thermocouple wires are not touching each other. Using the built-in thermocouple calibration program, ensure that the thermocouple reads within 5 °F at calibration temperatures of 67 °F and 2000 °F.
- 04-005 To certify, perform the following steps:
- a. Place the igniter in the nickel chromium wire coil and close the chamber door.
 - b. Pressurize the chamber to 14.7 psia with certified breathing air.
 - c. Turn on the igniter control power at the panel.
 - d. Initiate the testing by clicking the computer mouse at the "Start Test" box on the monitor. The peak flame temperature is obtained from the computer screen. The time from the moment of igniter ignition to the moment of flame extinction (burn time) is obtained using a calibrated stop watch. The flame height is determined by measuring the maximum height of the flame above the apex.

Record all the data within the igniter certification book.

- e. After the thermocouple reading indicates the chamber has returned to approximately room temperature, vent the chamber to ambient pressure. Before loading the next igniter, clean the nickel chromium wire coil by removing any ash residue from the coil with a soft bristled brush.

04-006 The batch of igniters are acceptable for NHB 8060.1 testing when one igniter out of the 20 tested igniters fails the specified criteria (04-002) within this WJI or when all of the tested igniters pass the specified criteria (04-002) within this WJI. Once the batch of igniters is tested and certified acceptable, the average peak flame temperature and average burn duration is calculated along with the sample deviations.

04-005 Any igniter waste produced from manufacturing, cutting, or weighing, including an entire batch that fails, must be placed into a beaker. Call the environmental section to coordinate the disposal of the igniter waste. Do not dissolve the waste in water prior to contacting the environmental section.

05-000 Packaging, storing, and shipping the igniters

- 05-001 Package the igniters in a plastic container with layers of 3.2 mm (1/8) thick foam corrugated wrap with the grooves facing up with the igniters sitting in the grooves to minimize movement when the box is stored or shipped. Place a piece of corrugated wrap with grooves facing down, 3.2 mm (1/8 in) thick foam, and then another layer of igniters in between two pieces of corrugated wrap, followed by another piece of 3.2 mm (1/8 in.) thick foam. To absorb any excess moisture which might affect the performance of the igniters place two 51 mm x 51 mm (2 in. x 2 in.), or equivalent, desiccant packets on top of the igniters inside the container.
- 05-002 The same container in which the igniters are shipped are used to store igniters. To prevent the igniters from absorbing moisture during an extended storage period, place the igniters in a desiccator with color changing desiccant. The igniters can be stored for an indefinite period of time as long as the desiccant is changed when the desiccant changes color or when the humidity indicator within the desiccator reads above 18% relative humidity.
- 05-003 Label each shipping container with clear legible characters. Include the following information on the label: identify the contents specifying quantity, date manufactured, date certified, batch number, average peak flame temperature, and average burn duration. The recorded flame temperatures and burn durations obtained when certifying the batch should accompany the igniters. In addition, include instructions on igniter use and storage requirements to avoid igniter decomposition and a questionnaire for feedback from the customer(s) with each the shipment. Place the box of igniters in a polyethylene bag and heat seal the bag. Place the previously sealed box of igniters in a second polyethylene bag along with two more packages of desiccant and heat seal the second polyethylene bag before placing the packaged igniters in the shipping box. The igniters are ready to be shipped.

**Attachment A:
Yearly Review of Document for Applicability**

Reviewed By: _____ Date:

Comments: